Harmonizing Net-centric Guidance – A Systems Engineering Perspective

FORCEnet Engineering Conference

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Purpose

- Discuss Systems Engineering (SE) considerations in acquisitions for a Net-centric DoD
  - Discuss SE perspectives
  - Promote SE processes and planning
  - Evoke discussion on practical SE approaches

Current Situation
What We Need to Do Better

Requirements

- Adapting to changing conditions
- ***Matching operational needs with systems solutions***
- Overcoming biases of Services and others
- Moving to transform military

PPBES

- ***Laying analytical foundation for budget***
- Aligning budgets with acquisition decisions

Personnel and Readiness

- Treating people as a resource

Acquisition

- ***Acquiring systems-of-systems***
- ***Making system decisions in a joint, mission context***
- Transitioning technology
- ***Assessing complexity of new work and ability to perform it***
- ***Controlling schedule and cost***
- ***Passing operational tests***
- Ensuring a robust industrial base

Sustainment

- ***Controlling O&S costs***
- Reducing logistics tails

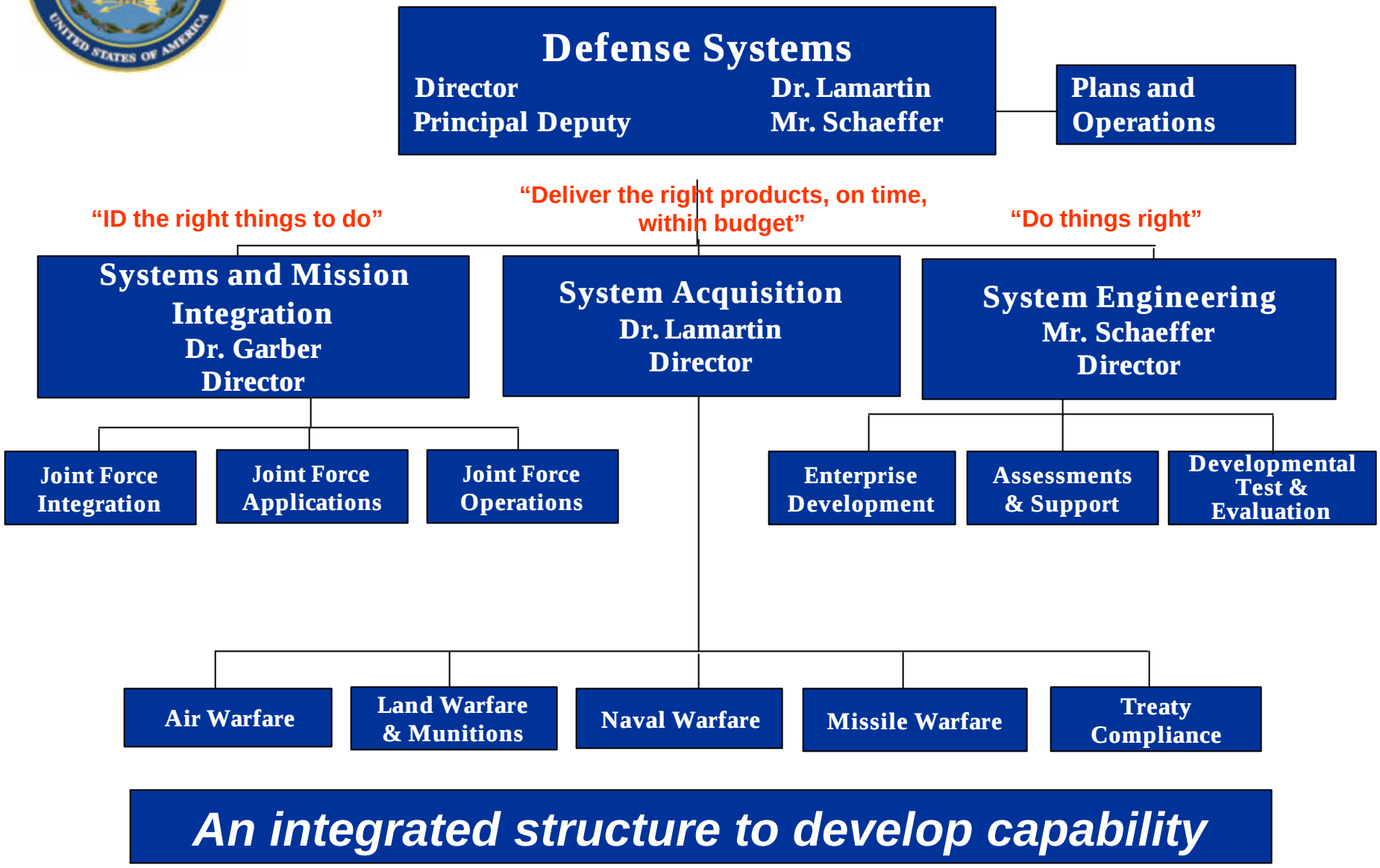
USD(AT&L) Imperatives

- “Provide a context within which I can make decisions about individual programs.”
- “Achieve credibility and effectiveness in the acquisition and logistics support processes.”
- “Help drive good systems engineering practice back into the way we do business.”

How Defense Systems is Responding

- Instituted a new Systems and Mission Integration organization
  - Engaging OSD, Joint Staff, Services, and COCOM staffs to define joint integrated architectures
  - Synchronizing the requirements, acquisition, and budget processes
- Warfare offices tailoring the application of DoD 5000
  - Leading IPT process for program oversight and review
  - Role is to help programs succeed
- Formed a new Systems Engineering organization
  - Institutionalizing Systems Engineering across DoD
  - Setting policy for implementation, capturing best practices, setting standards for training and education
  - Enhancing emphasis on system assessment and support

Organization of the Defense Systems Directorate, OUSD(AT&L)



An integrated structure to develop capability

Systems Engineering Directorate

"Do things right"

- Defines "good systems engineering" for the Department
- Finds, captures, and shares best practices
- Establishes systems engineering policy and procedures
- Implements education of government and industry workforce
- Conducts outreach with industry, academia, associations, individual programs, and others
- Directs and manages SE and SW studies and reviews
- Focal point for developmental test and evaluation
- Provides program support to Program Managers

What We Have Done To Revitalize Systems Engineering

- Issued Department-wide SE policy and provided implementation guidance
- Established SE Forum to ensure senior-level focus
- Instituted “context” briefings as part of Milestone Reviews
- Instituted system-level assessments to aid PMs
- Working with Defense Acquisition University to revise curricula
- Re-focused Warfare offices to help guide programs through the Milestone Review process
- Leveraged close working relationships with industry and academia
- Integrated DT&E with SE for policy and program assessments

USD(AT&L) Systems Engineering Policy

- All programs, regardless of ACAT shall
  - Apply an SE approach that balances system performance and total ownership cost within the family of systems, systems of systems context
  - Develop a Systems Engineering Plan (SEP) for MDA approval in conjunction with each Milestone review and integrated with the Acquisition Strategy
  - The Plan shall:
    - Describe technical approach to include processes, resources, and metrics
    - Detail timing, conduct, and success criteria of technical reviews

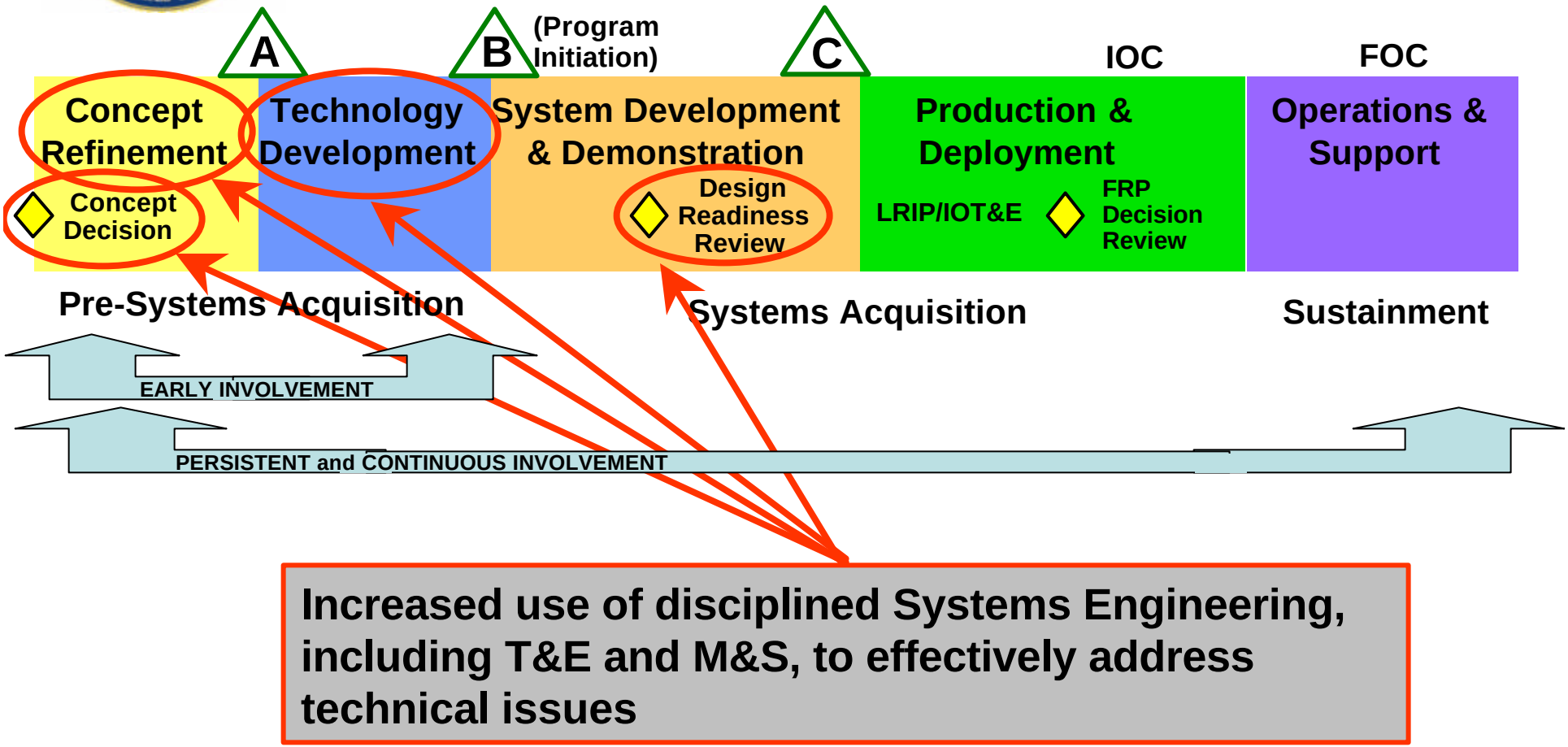
OUSD(AT&L)/Defense Systems Interim Guidance

- The SEP describes a program and/or system:
  - Systems engineering approach
    - Specific processes and their tailoring by phase
    - Both Program Management Office and Contractor processes
  - Systems technical baseline approach
    - Use as a control mechanism, including Technical Performance Measures and metrics
  - Technical review criteria and results
    - Event driven
    - Mechanism for assessing technical maturity and risk
  - Integration of SE with IPTs
    - Organization, SE tools, resources, staffing, metrics, integration mechanisms
    - Integration of SE activities with integrated schedules

Additional SE Guidance

- Preparing the Defense Acquisition Guidebook
  - SE guidance will be consolidated in one chapter (Chapter 4)
    - Services and components have reviewed via the Systems Engineering Forum
    - Plan to post online September 15 and to update quarterly
- Developing a Systems Engineering Plan (SEP) Guide
  - Guide will define SEP content as well as review and approval process
  - Formed a SEP Working Group (SEPWG) with service and component members

Opportunity for Greater SE Role in Acquisition



Increased use of disciplined Systems Engineering, including T&E and M&S, to effectively address technical issues

Systems Engineering
Developmental Test & Evaluation

- T&E is a key part of the systems engineering process – the “feedback loop”
- Roughly 75% of LCC is set by initial design process … the longer it takes to find and correct problems, the greater the impact
- A robust DT&E program can save money in the long run
  - Positive results give you confidence in design
  - Bad news, discovered early and corrected, gives you a better product, earlier
- We are integrating engineers with T&E experience into our assessment process to bring their expertise to you earlier

Current Challenges

- Focus shifting from platforms to capabilities and system solutions
- System complexity is increasing – Family of Systems and/or System of Systems interdependencies
- Demand for network centric capability drives higher levels of integration
- Functional and physical interfaces expanding in number and complexity
- Evolutionary acquisition institutionalizing change
- New approaches to testing balanced with modeling and simulation must match new systems views
- A disciplined systems engineering approach is imperative for success in this environment!

Only Better Systems Engineering can achieve Net-centric DoD

- The GIG is too complex to implement without rigorous SE
- The GIG as a “requirement” is often underestimated and poorly documented at the weapon system level
- The purpose of the weapon system within the GIG context must amplify not distract from mission
- M&S and testing are critical

Key Technical elements in achieving Net-centricity are often underestimated

- Demanding Design tenets:
  - Ubiquitous connectivity
  - Data Sharing
  - Service Oriented Architecture (SOA)
  - Information Assurance
- CONOPS
- End-to-End Testing

Analysis: requirements –> performance specs –> allocated baseline, etc…

SE challenges in "1st increment" planning

- Many GIG pieces are not yet defined or in early development -- What can you really do now?
- GIG is based on data sharing -- What are the available enablers for transport, data sharing?
- If data were available, how will your system use it?
- What is <u>your</u> systems delivery schedule and milestone?
- How does this match with GIG delivery schedules for services and capabilities that you will need?
- What is your test strategy?
- How will you ensure legacy interoperability?

Technical baseline management

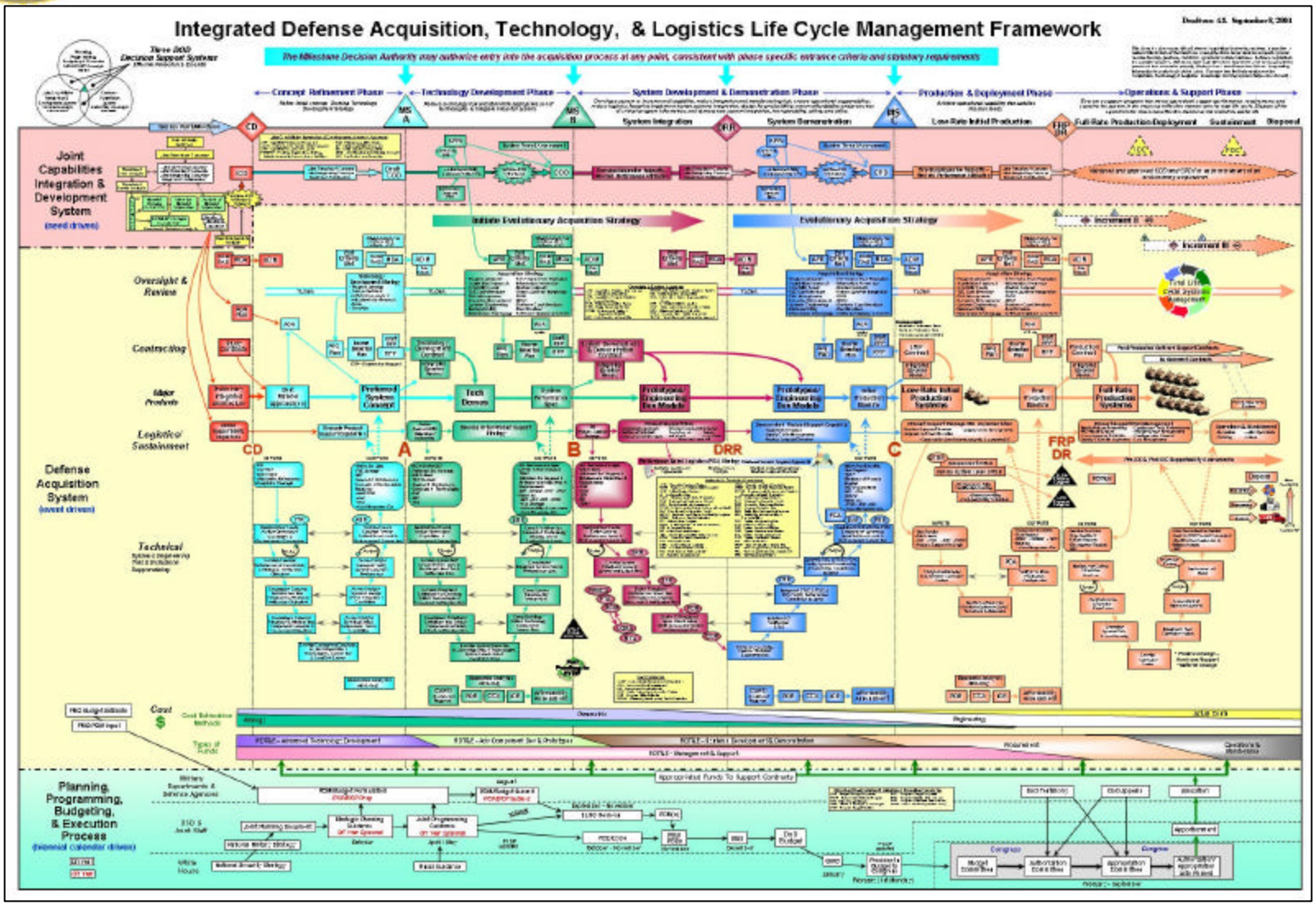
Summary

- GIG is evolving and complex (easy to say…hard to do!)
- Realistic understanding of requirements is key
- Controlling “requirements” creep is essential
- Effective test strategies ensure operational suitability and effectiveness

Sound Systems Engineering needed to inform decision making

Back-ups

SE in the System Life Cycle
"The Wall Chart"



Department's Policies & Guidance

Why

- **Policy** directives/instructions in place say that we will be Net-centric:
  - DoDD/I 5000 series (Acq.), 4630 (IT/NSS Interop.), 8100.1 (GIG), 8320 (Data Sharing in a Net-centric Environment)
  - CJCSI 3170 (JCIDS) , 6212 (IT/NSS – must have Net-Ready KPP, Key Interface Profiles (KIP))
  - Various ASD (NII) Policy memoranda; DepSecDef Memorandum on GIG Enterprise Services Core Enterprise Services (GIG ES-CES) Implementation, dated 5 Nov 2003; DoD Net-centric Data Strategy; IPv6;
  - Guidance: Data Visibility Component Guidance; Net-centric Checklist; Defense Acquisition Guidebook (DAG)

How

- **Architectural Mechanisms** established for net-centric readiness:
  - DoD IT Standards Registry (DISR) online: http://disronline.disa.mil/
  - DoD Architectural Framework (DODAF)
    - Previously C4ISR Architectural Framework, migrating to broader system context, DODAF)
  - Net-centric Operations/Warfare reference Model (NCOW RM)
  - Global Information Grid Architecture,
  - *Key Interface Profiles* (KIP)
  - DoD Discovery Meta-model Standard
- **GIG Architecture Implementation** in progress/development
  - GIG Net Centric Enterprise Services, Core Enterprise Services (NCES-CES)
  - GIG Teleport
  - Roadmaps (e.g., JBMC2), NCOE…

Lots of guidance

Policy & Guidance

NR-KPP	***Net-centric Checklist Ver 2.1.4***
Directived under DoDD/I 4630 and CJCSI 3170 series per CJCSI 6212.01C guidelines for ORDS (legacy), now capabilities dociments (CDD, CPD), sumbitted for JROC approval after 23 Dec 2003 (ORDS submitted prior to 23 dec 2003 grandfathered until next CDD/CPD update.)	Based on various NII memoranda and directives.* Not a directive itself. Stated purpose: "to assist program managers in understanding the net-centric attributes that their programs need to implement to move into the net-centric environment as part of a service-oriented architecture in the Global Information Grid."
Defined DODAF architectural product development: AV-1, OV-2, OV-4, OV-5, OV-6C, SV-4, SV-5, SV-6 TV-1 from DISR online	Ensuring that data are visible, available, and usable when needed and where needed to accelerate decision-making (implies metadata registration, data tagging, posting to "shared space", COI)
NCOW Reference Model "compliance," and CRD crosswalk of architectural descriptions	"Tagging" of all data (intelligence, non-intelligence, raw, and processed) with metadata to enable discovery of data by users (implies NCES/GES services, data registration)
Information Assurance statement	Posting of all data to shared spaces to provide access to all users except when limited by security, policy, or regulations (implies communities of interest - COI)
LISI profile of required interfaces	An integrated Identity Management, Permissions Management, and Digital Rights Management
Key Interface Profiles (KIP) (17 defined and under development - 6 have been released in draft form.)	Advancing the Department from defining interoperability through point-to-point interfaces to enabling "many-to-many" exchanges typical of a network environment

* Net-centric Checklist References:
DoD Directive 8320.2, Data Sharing in a Net-Centric Department of Defense
Department of Defense (DoD) Net-Centric Data Strategy: Visibility - Tagging and Advertising Data Assets with Discovery Metadata
DoD Net-Centric Data Strategy Memorandum

NR-KPP Required Views

View Type	#	Name	General Description	IC	CDD	CPDD
All Views	AV-1	Overview and Summary Information	Scope, purpose, intended users, environment depicted, analytical findings		X	
Operational	OV-1	High-Level Operational Concept Graphic	High-level graphical/textual description of operational concept	X		
	OV-2	Operational Node Connectivity Description	Operational nodes, operational activities performed at each node, connectivity and information exchange needlines between nodes		X	X
	OV-4	Organizational Relationships Chart	Organizational, role, or other relationships among organizations		X	X
	OV-5	Operational Activity Model	Operational activities and relationships among activities, inputs, and outputs. Overlays can show cost, performing nodes, or other pertinent information.		X	X
	OV-6c	Operational Event-Trace Description	One of three products used to describe the operational activity sequence and timing; traces actions in a scenario or sequence of events and specifies the timing of events		X	X
Systems	SV-4	Systems Functionality Description	Functions performed by systems and the information flow among system functions		X	X
	SV-5	Operational Activity to Systems Function Traceability Matrix	Mapping of systems back to operational capabilities or of system functions back to operational activities		X	X
	SV-6	Systems Data Exchange Matrix	Provides details of systems data being exchanged between systems		X	X
Technical	TV-1	Technical Standards Profile	Extraction of standards that apply to the given architecture		X	X

The 17 Key Interfaces

	Communications KIPs
1.	Logical Networks to DISN Transport Backbone
2.	Space to Terrestrial Interface
3.	JTF to Coalition
4.	JTF Component to JTF Headquarters
5.	Teleport (i.e., deployed interface to DISN)
6.	Joint Interconnection Service
7.	DISN Service Delivery Node
8.	Secure Enclave Service Delivery Node (e.g., SCI/Collateral KIP)
	Computing KIPs
9.	Application Server to Database Server
10.	Client to Server
11.	Applications to COE/CCP
	Network Operations KIPs
12.	End System to PKI
13.	Management Systems to (integrated) Management Systems
14.	Management Systems to Managed Systems
15.	IDM to Distribution Infrastructure
16.	Information Servers to IDM Infrastructure
	Applications
17.	Application Server to Shared Data (e.g., Situational Awareness Data KIP)

(Pilot Projects in Red)

UNCLASSIFIED

Figure 4 - SEVENTEEN TYPES OF KEY INTERFACES IDENTIFIED FOR GIG ARCHITECTURE V1.0

THE UNDER SECRETARY OF DEFENSE

3010 DEFENSE PENTAGON
WASHINGTON, DC 20301-3010

ACQUISITION, TECHNOLOGY AND LOGISTICS

FEB 20 2004

MEMORANDUM FOR: SEE DISTRIBUTION

SUBJECT: Policy for Systems Engineering in DoD

Application of rigorous systems engineering discipl
Department's ability to meet the challenge of developing a
warfighting capability. This is especially true as we strive
complex systems in a family-of-systems, system-of-systems
Systems engineering provides the integrating technical pro
system performance, cost, schedule, and risk. It must be e
and performed across the entire acquisition life cycle.

Toward that end, I am establishing the following po
to be included in the next revision of the DoD 5000 series

Systems Engineering (SE). All programs responding
requirements document, regardless of acquisition categ
robust SE approach that balances total system perform
ownership costs within the family-of-systems, systems-of-systems context.
Programs shall develop a Systems Engineering Plan (SEP) for Milestone
Decision Authority (MDA) approval in conjunction with each Milestone
review, and integrated with the Acquisition Strategy. This plan shall describe
the program's overall technical approach, including processes, resources,
metrics, and applicable performance incentives. It shall also detail the timing,
conduct, and success criteria of technical reviews.

In support of the above policy, the Director, Defense Systems shall:

a. Identify the requirement for a SEP in DODI 5000.2, and provide specific content guidance tailorable by the MDA in the Defense Acquisition Guidebook.

b. Assess the adequacy of current Department-level SE related policies, processes, practices, guidance, tools, and education and training and recommend to me necessary changes.

Systems Engineering (SE). All programs responding to a capabilities or requirements document, regardless of acquisition category, shall apply a robust SE approach that balances total system performance and total ownership costs within the family-of-systems, systems-of-systems context. Programs shall develop a Systems Engineering Plan (SEP) for Milestone Decision Authority (MDA) approval in conjunction with each Milestone review, and integrated with the Acquisition Strategy. This plan shall describe the program's overall technical approach, including processes, resources, metrics, and applicable performance incentives. It shall also detail the timing, conduct, and success criteria of technical reviews.

SEP Focus Areas for Technical Planning, Version 0.95

References:

- *Memorandum: Policy for Systems Engineering in DoD, Michael W. Wynne (Acting), Under Secretary of Defense (Acquisition, Technology, and Logistics), 20 February 2004*
- *Memorandum: Policy Addendum for Systems Engineering, Michael W. Wynne (Acting), Under Secretary of Defense (Acquisition, Technology, and Logistics), 22 October 2004*
- *Memorandum: Implementing Systems Engineering Plan in DoD- Interim Guidance, Dr. Glenn F. Lamartin, Office of the Under Secretary of Defense (Acquisition, Technology, and Logistics), Director, Defense Systems, 30 March 2004*

KEY: DAG=Defense Acquisition Guidebook
SEP PG=Systems Engineering Plan Preparation Guide, Version 0.95

SEP Five Focus Areas	References	
A. Program Requirements	DAG	SEP PG
1. Does the SEP reflect the program team's understanding of the program's desired capabilities, concept(s) of operation, and key performance parameters (KPPs) for the program?	4.1.3 and 4.2.4.1	3.4.1
2. Does the SEP reflect the program team's understanding of the program's statutory and regulatory requirements applicable to the program?	4.2.4.1	3.4.1
3. Does the SEP reflect the program team's understanding of the program's specification performance requirements, both specified and derived?	4.2.4.1	3.4.1
4. Does the SEP reflect the program team's understanding of the program's certification requirements applicable to the program?	4.2.4.1	3.4.1
5. Does the SEP reflect the program team's understanding of the program's design considerations?	4.2.4.1 and 4.4	3.4.1

B. Technical Staffing and Organization Planning	DAG	SEP PG
1.Does the SEP describe how technical authority will be implemented on the program to address the full spectrum of program requirements?	4.1.6	3.4.2
1.Does the SEP describe the authorities and role of the lead or chief systems engineer and systems engineering teams?	4.1.2 and 4.1.6	3.4.2
1.Does the SEP describe how systems engineering activities will be integrated within and coordinated across IPTs to include peer programs and higher-level systems engineering authorities for family-of-systems and system-of-systems programs, if applicable?	4.1.2; 4.1.6; (4.2.6)	3.4.2
1.Does the SEP describe how IPTs will be organized, and their resources, staffing, management metrics, integration mechanisms, staff training needs, and responsibilities relative to the technical baseline products?	4.1.5; 4.1.6	3.4.2
1.Does the SEP address overall organization of Government and contractor systems engineering tasks, activities, and responsibilities (requirements, technical baseline, technical reviews, etc) from prime contractor down to lowest level supplier?	4.1.6	3.4.2
C. Technical Baseline Management Planning	DAG	SEP PG
1.Does the SEP describe who is responsible for managing the technical baselines?	4.1.6	3.4.4
1.Does the SEP describe a plan for how the system's technical baseline will be defined and managed?	4.2.3.6; 4.2.3.7; 4.2.3.8	3.4.4
1.Does the technical baseline approach account for requirements traceability and requirements verification across all of the program's technical requirements?	4.2.3.4; 4.2.3.6; 4.2.3.7; 4.2.3.8; 4.2.4.6	3.4.4
1.Does the technical baseline map across the entire specification tree (CDD to build-to documents) and across the entire work breakdown structure (WBS)?	4.2.3.6; 4.2.3.7; 4.2.3.8	3.4.4
1.Does the SEP describe how the technical baseline is used to assess technical maturity and risk?		3.4.4

D. Technical Review Planning	DAG	SEP PG
1.Does the SEP detail what event-driven technical reviews will be conducted at a system, subsystem, and configuration item level; are entry/exit criteria defined and documented; the planned schedule for technical reviews; and is the approval of the technical baselines a product of the appropriate review?	4.2.3.3, 4.3, 4.3.1.4, 4.3.2.4, 4.3.3.4, 4.3.3.9, 4.3.4.4, 4.3.5.4, 4.5.1, and 4.5.8	3.4.4
1.Does the SEP describe who is responsible for overall management of the technical reviews to be conducted on the program?	4.1.6	3.4.4
1.Does the SEP describe how technical authority is being accessed and applied to chair each of the technical reviews?	4.2.3.3, 4.3, 4.3.1.4, 4.3.2.4, 4.3.3.4, 4.3.3.9, 4.3.4.4, 4.3.5.4, 4.5.1, and 4.5.8	3.4.4
1.Does the SEP detail, for each review (system, subsystem, and configuration item), what stakeholders are to be involved and are the stakeholders reflective of the totality of technical requirements, spanning KPPs, statutory, regulatory, certification requirements, and all design considerations (e.g., mass properties)?	4.2.3.3, 4.3, 4.3.1.4, 4.3.2.4, 4.3.3.4, 4.3.3.9, 4.3.4.4, 4.3.5.4, 4.5.1, and 4.5.8	3.4.4
1.Does the SEP detail how the program will identify peer (independent subject matter experts) review participants in each of the technical reviews?	4.2.3.3, 4.3, 4.3.1.4, 4.3.2.4, 4.3.3.4, 4.3.3.9, 4.3.4.4, 4.3.5.4, 4.5.1, and 4.5.8	3.4.4

E. Integration with Overall Management of the Program	DAG	SEP PG
1.Does the SEP integrate the systems engineering approach with overall program management planning and control efforts such as integrated master planning, the program's integrated master schedule, and earned value management system?	4.5.2; 4.5.3; 11.3; 11.3.1	3.4.5
1.Does the SEP describe how the program manager uses technical reviews to manage the technical effort?		3.4.5
1.Does the SEP integrate the systems engineering approach with the program's risk management effort (e.g., does the SEP detail how the technical reviews provide a technical risk assessment input to the risk management process)?	4.2.3.5; 11.4	3.4.5
1.Does the SEP integrate test and logistics planning within the systems engineering approach?	4.1.3, 4.2.4.6, 4.2.4.7, Ch 9, T&E, Ch 5, and Log	3.4.5
1.Does the SEP address contracting considerations for systems engineering?	4.2.5	3.4.5